FISHERY MANAGEMENT INVESTIGATIONS

IDAHO DEPARTMENT OF FISH AND GAME
FISHERY MANAGEMENT ANNUAL REPORT

Ed Schriever, Director

SOUTHEAST REGION
2017

Arnie Brimmer
Regional Fishery Biologist
Ryan Hillyard
Regional Fishery Biologist
Kaden Buer
Fisheries Technician
David Teuscher
Regional Fishery Manager

February 2020
19-101

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LOWLAND LAKE AND RESERVOIR INVENTORIES AND SURVEYS

ABSTRACT

Bear Lake was trawled for Bear Lake Sculpin *Cottus extensus* during August. We captured an average of 138 adult sculpin per trawl, which converts to a population estimate of about 5 million, well above the minimum management objective of 1 million. We evaluated Largemouth Bass *Micropterus salmoides* (LMB) and Bluegill *Lepomis macrochirus* (BG) size structure using proportional stock density (PSD) in four Franklin County reservoirs in June. Johnson Reservoir had the highest LMB PSD estimate of 38, followed by Glendale (37), Condie (27), and Twin Lakes (22). Bluegill PSD was highest in Condie (91) and lowest in Glendale (17). Largemouth Bass PSDs were most consistent over time in Glendale Reservoir, which is managed under a moderately conservative harvest rule (2 bass, none under 406 mm). We continued trophy trout monitoring on Daniels and Treasureton reservoirs. Despite the same harvest rule (2 trout, none under 508 mm), the mean size of trout caught in Treasureton Reservoir is consistently greater than Daniels Reservoir. We suspect one reason for the difference may be due to higher angler harvest rates at Daniels Reservoir. Treasureton anglers tend to practice catch and release techniques, while Daniels anglers are more harvest-oriented. Alternatively, growth rates of Treasureton trout may simply be higher on average than Daniels' trout growth rates.

Authors:

Arnie Brimmer
Fisheries Biologist

Ryan Hillyard
Fisheries Biologist

David Teuscher
Regional Fishery Manager

BEAR LAKE SCULPIN TRAWLING

INTRODUCTION AND METHODS

Bear Lake is a 28,328 ha lake located in northern Utah and southeast Idaho. The Utah-Idaho border roughly bisects the 32 km long lake in half and the lake is 8-13 km in width. It has a maximum elevation of 1,806 m above sea level. The maximum depth, when at full pool, is 63 m and average depth is 26 m. Most of the lakebed is covered in fine marl sediment. Primary and secondary production are thought to be limited by precipitation of calcium carbonate, which strips phosphorous from the water column (Birdsey 1989). The precipitate also gives the lake its famous turquoise iridescence.

St. Charles, Swan, Big Spring, and Fish Haven creeks are the primary natural tributaries to the lake. In addition to the natural tributaries, the Bear River is diverted into Bear Lake. In 1911, a canal was constructed to divert the Bear River at Stewart Dam into Bear Lake. The water delivery system stores spring runoff water in Mud Lake, which gravity flows into the northeast corner of Bear Lake. PacificCorp operates the top 6.4 m of the lake as irrigation storage through a legal decree (Kimball Decree). The stored water is pumped out of the lake during the summer irrigation season and delivered back to the Bear River through the outlet canal.

Bear Lake's fish community supports four endemic species: Bonneville Whitefish (*Prosopium spilonotus*), Bear Lake Whitefish (*P. abyssicola*), Bonneville Cisco (*P. gemmifer*), and Bear Lake Sculpin (*Cottus extensus*). Bear Lake also supports one of two remaining native adfluvial stocks of Bonneville Cutthroat Trout (*Oncorhynchus clarkii utah*).

In 2010, the Bear Lake Management Plan (Plan) was finalized, which specifically outlined a monitoring program for Bear Lake Sculpin. Bear Lake Sculpin (sculpin) have been monitored since the 1980's, first by Utah State University and later by the Utah Division of Wildlife Resources. In 2010, Idaho Department of Fish and Game took over monitoring responsibilities. The management objective for Bear Lake Sculpin is to maintain a minimum population of 1-2 million adult sculpin which translates to a mean density of 25 – 50 age-1 (or older) sculpin captured per standard 20 minute trawl. If sculpin numbers fall below a mean density of 25 adults/trawl (1 million sculpin), then Lake Trout (*Salvelinus namaycush*) stocking will cease and Bonneville Cutthroat Trout stocking may be reduced until the sculpin population rebounds. For complete details on the Bear Lake Management Plan, see Tolentino and Teuscher (2010).

Bear Lake Sculpin were sampled during the new moon phase from August 21-23, 2017. We sampled sculpin with a semi-balloon otter trawl with a head rope of 4.9 m attached to two otter boards. The net had a mesh size of 12.7 mm with the cod-end containing a 5.0 mm mesh liner. We sampled at three locations (First Point, Gus Rich, and Utah State Marina; Figure 1). Trawling was conducted at two depths, (1) where the top of the thermocline intersected with the lakebed (10 m) and (2) where the bottom of thermocline intersected with the lakebed (19 m). At each location, we normally complete a total of six 20-minute trawls (three at the top and three at the bottom of the thermocline) for a total of 18 trawls. However, in 2017, we lost the bottom trawl and were unable to finish the last four surveys near the Utah State Marina. Boat speed was maintained as close to one m/s as possible. Trawling began at about 21:00 hrs and ended at approximately 04:00 hrs. All adult (>35 mm) Bear Lake Sculpin and non-target fish were counted and measured (total length) to the nearest millimeter and released. Young-of-the-year sculpin were counted and released.

RESULTS AND DISCUSSION

Adult sculpin density was lowest in shallow trawls and averaged about 107 adult sculpin per trawl (*n* = 6). For deep trawls, mean adult sculpin density was 162/trawl (*n* = 8; Figure 2). Mean sculpin densities varied from a high of 200/trawl (*n* = 6) at Gus Rich to a low of 48/trawl (*n* = 2) at Utah State Marina. It is likely that the low number of sculpin/trawl observed at Utah State Marina was a function of small sample size. The overall mean adult sculpin (≥ 35 mm) catch per trawl was 138 (*n* = 14), which converts to a minimum population estimate of about 5 million adult sculpin. Figure 3 presents overall mean adult sculpin trends for the past 15 years.

LARGEMOUTH BASS SURVEYS

INTRODUCTION AND METHODS

In the early 1990's, a comprehensive research study was initiated to better understand the biology of Largemouth Bass *Micropterus salmoides* (LMB) in Idaho (Dillon 1991). A conclusion of that work indicated that water temperature was a key factor controlling LMB growth. Several other studies described growth potential of LMB across their natural range (McCauley and Kilgour 1990; Beamesderfer and North 1995). Those studies coupled with Dillon (1991) identify the maximum growth potential for LMB in the predominately coldwater lakes and reservoirs in Idaho. However, many other factors can contribute to the population structure and success of a LMB fishery. Most importantly are harvest, lake productivity, and interaction among fish species (i.e., competition and predation). Monitoring those variables is necessary to maintain or improve LMB fisheries in southeast Idaho.

Electrofishing surveys were completed on four southeast Idaho reservoirs in 2017. All of the reservoirs are small (< 200 ha), shallow, and productive. Table 1 shows reservoir name, elevation, surface area, species composition, and current LMB harvest regulations.

Largemouth Bass and potential prey species abundance were evaluated using shoreline electrofishing. Target species included LMB and Bluegill *Lepomis macrochirus* (BG). Catch-per-unit-effort (CPUE) was used to compare the relative abundance of LMB among the different reservoirs. The CPUE data were collected using night-time shoreline electrofishing with boat-mounted equipment. All electrofishing was completed in June between 21:00 and 04:00 hours. Occasionally, we were unable to reach our sample goal of 100 LMB during our first, multi-species survey at each reservoir. When this occurred, we completed subsequent surveys until we reached our LMB goal. During these latter surveys, we only netted LMB. We used data from the multi-species surveys to analyze CPUE and PSD for both BG and LMB. We combined LMB data from both survey types to analyze size structure. Sampled fish were weighed to the nearest gram, measured for total length (mm) and released.

RESULTS AND DISCUSSION

Catch rates of warmwater species varied markedly among reservoirs. Bluegills were most abundant in Johnson Reservoir followed by Twin Lakes, Condie, and Glendale Reservoirs, respectively (Table 2). Largemouth Bass were most abundant in Glendale Reservoir and the least abundant in Twin Lakes Reservoir (Table 2).

Proportional stock density trends for most of the Southeast Region reservoir fisheries are highly variable (Table 3). Protective harvest regulations may moderate the fluctuations in PSDs, but do not appear to guarantee quality fishing. For example, Condie Reservoir is managed using the trophy bass rule of no harvest of LMB under 508 mm. The trophy bass rule has been in effect since 1990. Despite the conservative harvest rule, the PSD in this reservoir fluctuates widely and has fallen below 40 (40 – 60 is the ideal range; Gablehouse 1984) five times since the rule change took effect in 1990 (Table 3). This variability suggests that the current rule may be too conservative. As mentioned above, Condie Reservoir is managed under a trophy bass rule. Length-at-age data analyzed from 2002 samples showed that Condie contained an old, slow growing population of LMB. Furthermore, prey species (e.g. BG) occurred at low densities and comprised a low percentage of LMB diet (Teuscher 2006). Based on the cyclic nature of the LMB population, Teuscher (2002) hypothesized that as the LMB population ages and BG densities decline, that LMB convert to cannibalism. This conversion to cannibalism may explain the cyclic (i.e. lack of LMB recruitment) every few years. A change from a trophy bass rule to a quality bass rule might provide much needed stability to this LMB population. Glendale Reservoir is managed under a quality bass rule (2 bass, none under 406 mm). The PSDs for bass in this fishery have fallen below the ideal range only twice since the rule changed in the mid 1990's. The lowest LMB PSDs have been consistently observed in reservoirs that were managed under general angling regulations (6 bass, 305 mm minimum harvest length), suggesting that once LMB are recruited to legal size, they are harvested by anglers (Figure 4). In response to these consistently low PSDs, we increased the harvest length limit for LMB from 305 mm (12 inches) to 355 mm (14 inches) in 2016. Over the next few years, LMB PSDs should increase as the result of this change and increase the number of bass of quality size.

Similar to LMB, BG PSDs were also variable in the reservoirs surveyed. Condie had the highest BG PSD (91) followed by Twin Lakes (68), Johnson (58), and Glendale (17) reservoirs (Table 2). Generally, the BG PSDs we observed were within or exceeded the desired range of 50 – 80 with one exception (Gablehouse 1984). The Glendale BG population appears to be underperforming despite a LMB rule that should promote a relatively high BG PSD. However, we think the reason for the low PSD observed in Glendale BG was due to small sample size (n = 18) rather than an ineffective LMB rule.

TROPHY TROUT WATERS

INTRODUCTION AND METHODS

Daniels Reservoir is a 152 ha reservoir situated at an elevation of 1,573 m. Located in Oneida County, Daniels Reservoir is owned by the St John's Irrigation Company and was constructed in 1970. As with all new reservoirs, it enjoyed high productivity during the first few years after construction. Anglers remember abundant, fast-growing trout caught in the 1970s. Non-game fish, notably Utah suckers *Catostomus ardens*, then colonized the reservoir. Department personnel chemically renovated Daniels Reservoir in 1988. It currently has a trophy trout regulation of two trout, none under 20", combined with a barbless hook no-bait restriction.

Treasureton Reservoir is located on Battle Creek in Franklin County. Its primary function is irrigation storage and flood control. Secondarily, the reservoir provides excellent sportfishing opportunities. The dam and reservoir are owned and operated by the Strongarm Reservoir Company. At full capacity, the reservoir is at 1,645 m elevation, covers 58 ha and contains 2,280,000 m3 of water. The reservoir had been managed as a year-round fishery based on stocking of catchable-sized hatchery Rainbow Trout *Oncorhynchus mykiss*. In 1994, management changed to quality management with a two-trout (none between 12” and 16”) limit. In 2008, management again changed to a two-trout (none < 20”) harvest limit. Both Treasureton and Daniels reservoirs are currently stocked with Troutlodge triploid Rainbow Trout (RBT). The objectives of the surveys were to collect RBT from both bodies of water to assess the size structure, Relative Weight (Wr), and relative abundance (catch per unit effort, CPUE) of each population. The last objective was to assess zooplankton size structure from both reservoirs to determine if competition for prey items was occurring.

Electrofishing surveys were completed on both reservoirs in 2017. We used a boat mounted electrofishing unit using standard pulsed DC waveforms to survey both bodies of water. Surveys were conducted from 2100 to 0400 hours at each reservoir. All fish captured were anesthetized, measured for total length (mm), weighed to the nearest gram (g), and released.

We sampled zooplankton at both reservoirs about every other year from 2010-2017. We conducted all surveys during August. In both reservoirs, samples were collected from three locations; the upper, middle, and lower (near the dam) sections. We performed three vertical tows, using Wisconsin-style plankton nets with mesh sizes 153 μm, 500 μm, and 750 μm, at each location following methods outlined in Teuscher (1999). Samples were stored in 100% ethyl alcohol for about 10 days, at which time contents were weighed and zooplankton ratio index (ZPR) and zooplankton quality index (ZQI) were calculated (Teuscher 1999). Zooplankton quality index and ZPR values less than 0.60 indicate competition for forage is likely occurring.

RESULTS AND DISCUSSION

On 4 and 10 October, we sampled a total of 122 trout from Treasureton Reservoir (Treasureton) and 193 trout from Daniels Reservoir (Daniels), respectively. Rainbow Trout (trout) collected from Treasureton had a mean length (± 90% CI) of 404 ± 13 mm and a mean weight of 801 ± 71 g. Mean length and weight of trout sampled from Daniels Reservoir was 373 ± 9 mm and 605 ± 32 g, respectively (Table 4). Mean relative weight of trout surveyed from each reservoir were similar. Trout captured from Treasureton had a mean W_r of 93, while fish sampled from Daniels had a W_r of 94. These results indicate the trout sampled were in good condition and that prey resources did not appear to be limiting growth.

The mean ZQI calculated from Treasureton zooplankton samples was higher than that for Daniels zooplankton. The mean ZQI (n = 6) from Treasureton and Daniels were 1.9 and 0.8, respectively. Both values were above the threshold where competition for prey resources occurs (0.60; Teuscher 1999).

Both Treasureton and Daniels reservoirs are managed under the same trophy trout rule. However, the size structure of the trout population differs between the two waters (Figure 5). Over the last two survey periods, we have consistently captured greater numbers of trout exceeding 508 mm (20”) from Treasureton than from Daniels. Plankton sampling suggest that prey resources are not limiting these trout populations. Therefore, a non-biological mechanism may be the reason for the lack of large trout (> 508 mm) in the Daniels fishery.

Over the course of the last nine years, anglers utilizing Treasureton and Daniels reservoirs have been occasionally contacted by Department personnel. Over the course of our discussions with anglers, two consistent responses emerged. Generally, Treasureton anglers tended to practice catch-and-release angling techniques. However, Daniels anglers indicated they preferred to harvest fish when possible. Based on our discussions with anglers, we think it is possible that few legal trout persist in the Daniels fishery because once they recruit to legal size, they are harvested.

Alternatively, differential growth rates of these two populations of trout may explain the differences in size structure. Dillon et al. (1995) showed that trout sampled from Treasureton over the course of several years exhibited higher growth rates than trout sampled from Daniels during the same time frame. However Teuscher et al. (2003 found that growth rates for Treasureton trout were higher than Daniels trout for the first two years following stocking. However, during the third year following stocking, Daniels trout grew at a faster rate. Both researchers are in agreement that water year likely plays a large role in trout growth rates in both reservoirs. The contradictory nature of these two studies indicates further growth studies as well as angler exploitation studies are needed to more fully understand the mechanisms that affect trout size structure in Daniels and Treasureton reservoirs.

MANAGEMENT RECOMMENDATIONS

1. Evaluate Largemouth Bass regulation change that occurred in 2016.

2. Evaluate trout growth and angler exploitation at Daniels and Treasureton Reservoirs.

Table 1. Species composition and harvest regulations for reservoirs included in the 2017 Largemouth Bass surveys.

Water	Elevation (m)	Surface Area (ha)	Species Composition	Harvest Regulations
Condie	1,500	47	LMB[a], BG[b], YP[c]	2 none under 20”
Glendale	1,509	93	LMB, BG, YP, RBT[d],CR[e]	2 none under 16”
Johnson	1,485	20	LMB, BG, YP, RBT	6 none under 14”
Twin Lakes	1,452	180	LMB, BG, YP, RBT, CR	6 none under 14”

[a] Largemouth Bass.
[b] Bluegill.
[c] Yellow Perch.
[d] Rainbow Trout.
[e] Crappie.

Table 2. Catch-per-hour of electrofishing effort in five southeast Idaho reservoirs in 2017. Proportional Stock Density values for Largemouth Bass (LMB) and Bluegill (BG) are shown in parenthesis.

Species	Condie		Glendale		Johnson		Twin Lakes	
LMB	146	(27)	176	(37)	149	(38)	63	(22)
BG	49	(91)	29	(17)	95	(58)	86	(68)

Table 3. Trends in Proportional Stock Density (PSD) for select Largemouth Bass populations in reservoirs of southeast Idaho.

Year	Condie	Johnson	Glendale	Lamont	Winder
1986				13	
1987					
1988	30		9		10
1989					
1990					
1991					
1992				3	
1993	21		6	1	25
1994	58				
1995				1	
1996					
1997					
1998			83		
1999	43				
2000					
2001					
2002	97		56	8	0
2003	14				
2004					
2005					
2006	20		56	13	78
2008	90		23		
2010	36	12	84	8	
2011	57	26			33
2013	88	17	60	11	
2014		26			
2015	68	33		31	5
2017	27	38	37		

Table 4. Total length and weight (± 90% CI), relative weight (W_r), sample size, and catch per unit effort (CPUE, fish/h) of Rainbow Trout collected from Treasureton and Daniels reservoirs, Idaho, during the fall of 2017.

Reservoir	Mean length (mm)	Mean wt. (g)	W_r	n	CPUE
Treasureton	404 ± 13	801 ± 71	93	122	206
Daniels	373 ± 9	605 ± 32	94	193	365

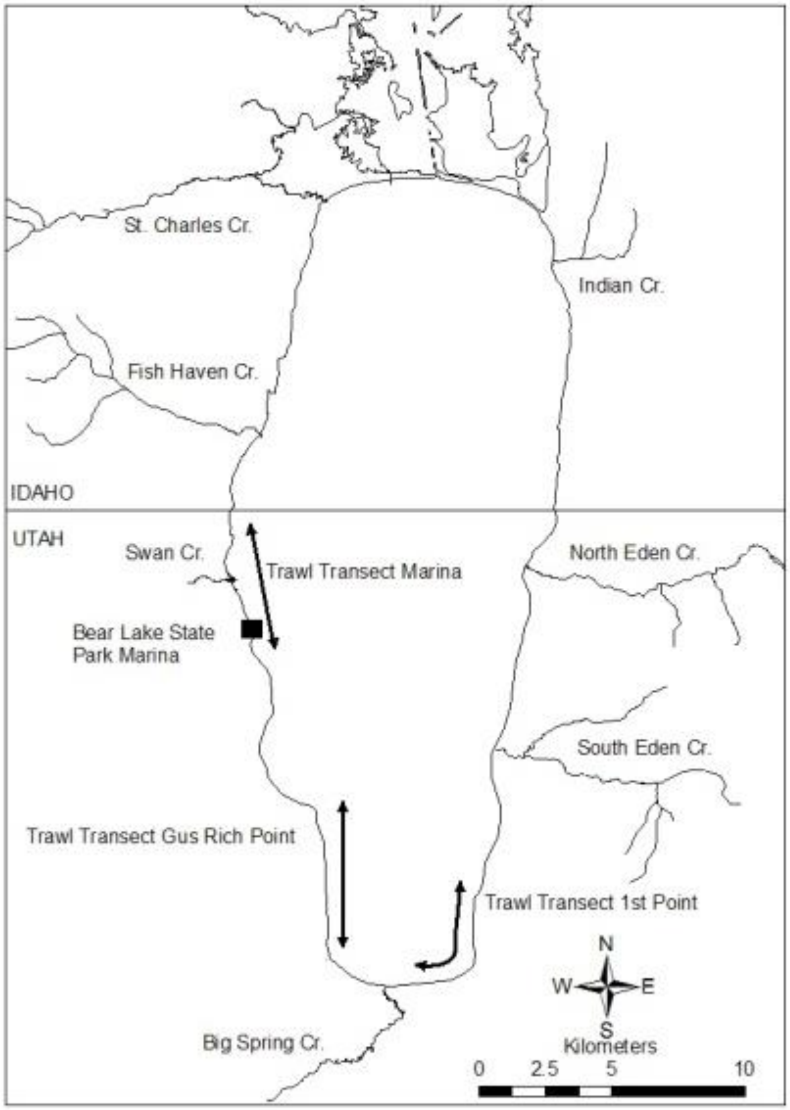

Figure 1. Locations within Bear Lake, Idaho/Utah, where Bear Lake Sculpin were sampled via bottom trawl in 2017.

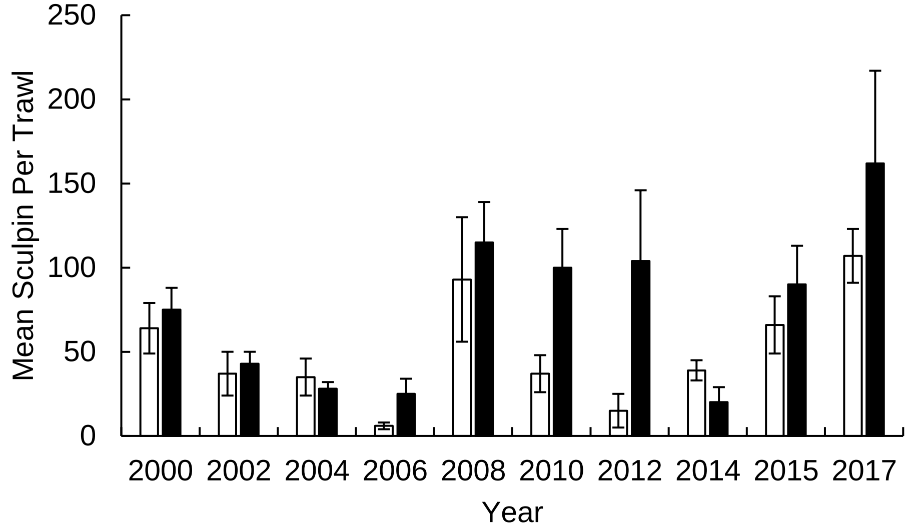

Figure 2. Bear Lake Sculpin mean catch per trawl with standard error. White bars represent samples collected from the top of the thermocline where it intersected with the lakebed, and the black bars represent samples collected from the bottom of the thermocline where it intersected with the lakebed. All trawls were 20 minutes in duration. Mean catch per trawl reported for 2017 was based on a sample size of 12. Mean catch per trawl for all other years were based on sample sizes of 18.

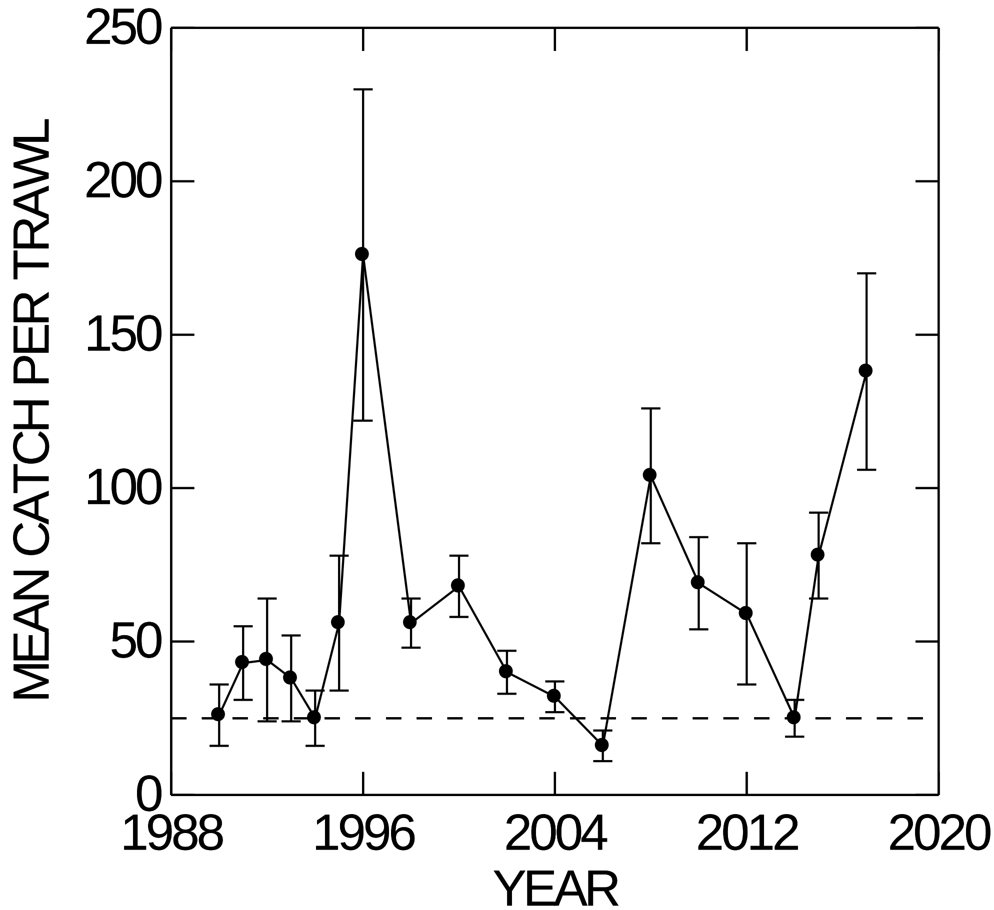

Figure 3. Mean catch (●) and standard error (I) per trawl for Bear Lake Sculpin collected from Bear Lake Idaho/Utah. Each trawl was 20 minutes in duration. The horizontal dashed line represents the minimum acceptable Bear Lake Sculpin population of 1 million as defined in the Bear Lake Management Plan (Tolentino and Teuscher 2010).

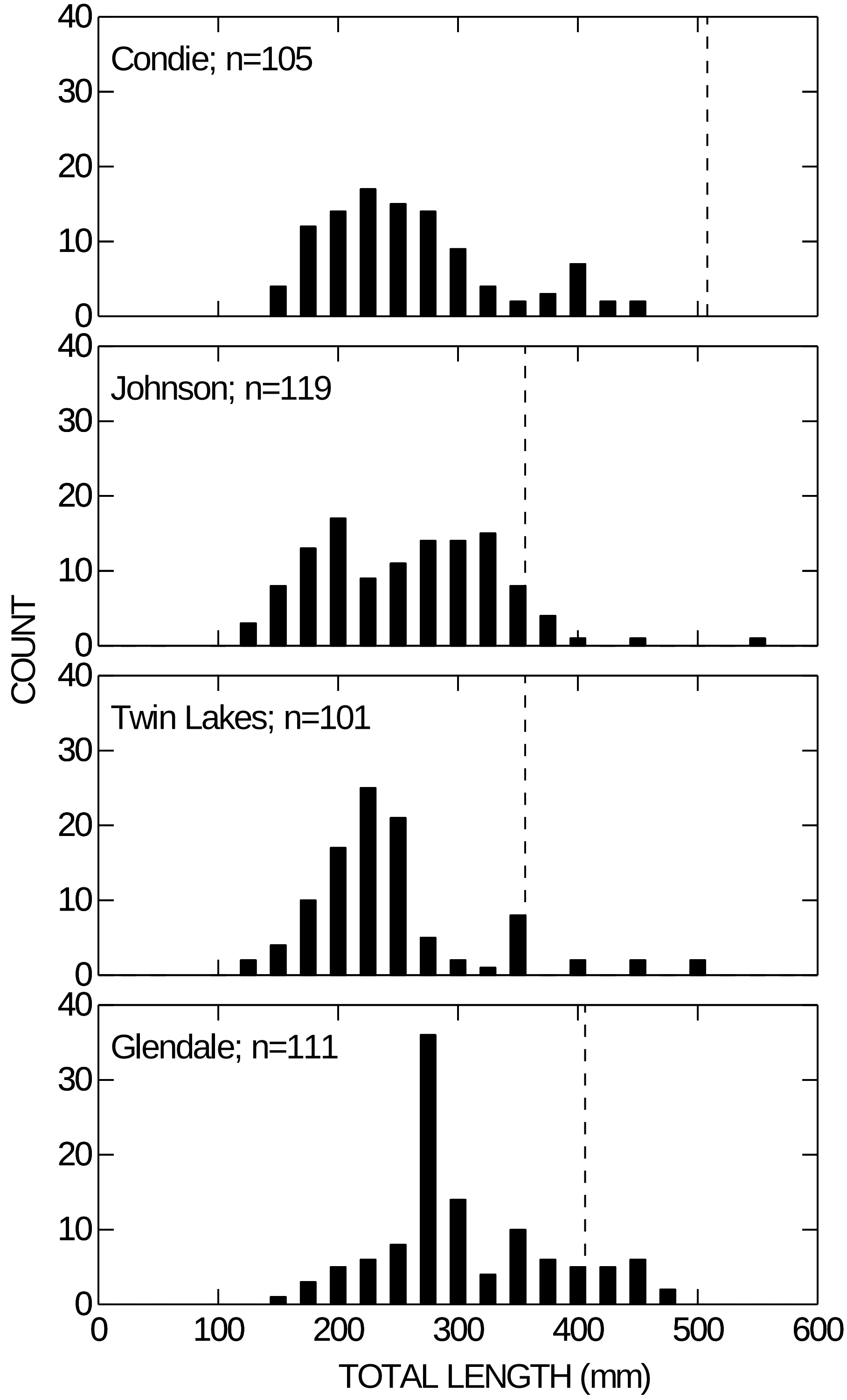

Figure 4. Largemouth Bass length frequency distributions collected from various Southeast Idaho reservoirs in 2017. The vertical dashed lines represent the minimum legal length limit for harvest.

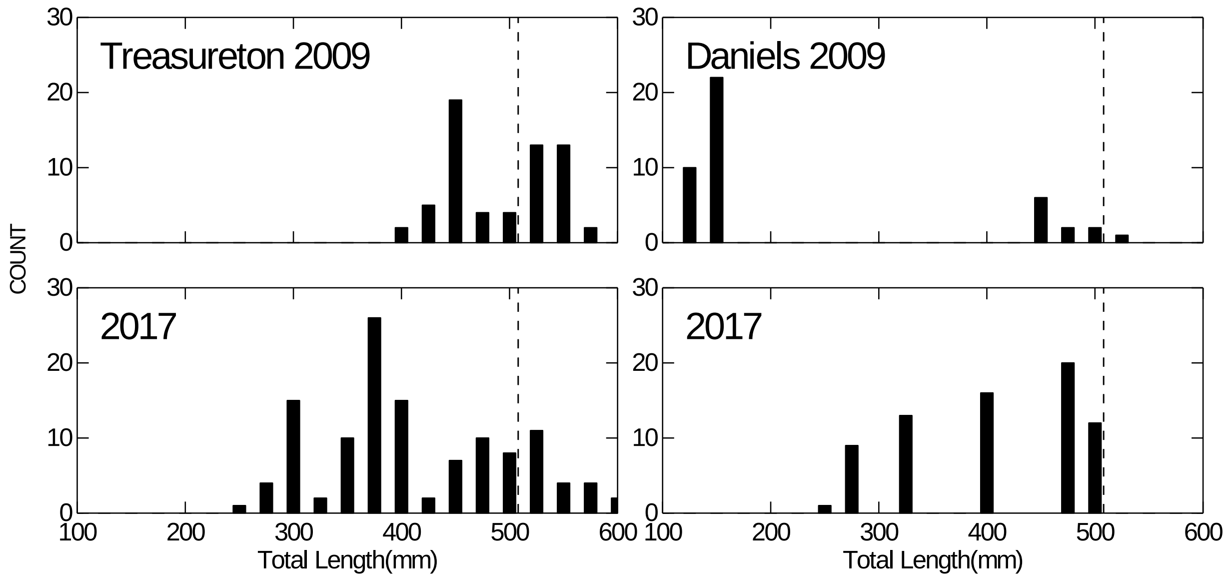

Figure 5. Length frequency distribution of Rainbow Trout collected from Treasureton and Daniels reservoirs. Both reservoirs are managed under a trophy trout regulation (2 trout, none < 20", no bait, barbless hooks). The 20" minimum length limit (508 mm) is represented by the vertical dashed lines.

RIVERS AND STREAMS INVESTIGATIONS AND SURVEYS

ABSTRACT

We surveyed the Blackfoot River fish community using electrofishing in 2017. The Yellowstone Cutthroat Trout *Oncorhynchus clarkii bouvieri* (YCT) population on the Blackfoot River Wildlife Management Area continues to be below historical levels. We think the low YCT population can be attributed to continued predation by American White Pelicans *Pelecanus erythrorhynchos*. During July and August, we sampled eight streams within the Thatcher, Riverdale, and Malad management units for Bonneville Cutthroat Trout *O. c. utah* (BCT). Overall, BCT densities were higher in 2017 than in 2015 when these streams were last sampled. We analyzed 20 years of creel data (1997 - 2017) for the Snake River below American Falls Dam to determine if the addition of the winter catch-and-release season that began in 2011 has negatively impacted the summer harvest fishery. Our results show catch rates and size structure of trout harvested did not decrease after initiation of the catch-and-relase winter fishery. In fact, the harvest rate of trophy-sized trout (> 508 mm) has increased over the past decade. We think the increase in size structure can be attributed to switching from stocking diploid Hayspur stock to triploid Troutlodge stock Rainbow Trout (RBT). Triploid RBT stocks tend to produce larger fish than diploid stocks due to their longenvity.

Authors:

Arnie Brimmer
Fisheries Biologist

Ryan Hillyard
Fisheries Biologist

Kaden Buer
Fisheries Technician

David Teuscher
Regional Fisheries Manager

YELLOWSTONE CUTTHROAT TROUT MONITORING IN THE BLACKFOOT RIVER SYSTEM

INTRODUCTION AND METHODS

There are two long-term monitoring programs in place for Yellowstone Cutthroat Trout *Oncorhynchus clarkii bouvieri* (YCT) in the upper Blackfoot River. They are adfluvial escapement estimates and river density estimates. Adfluvial escapement estimates are derived from fish captured at an electric fish migration barrier (electric weir) located in the lower river near its confluence with Blackfoot Reservoir. The density estimates are derived from fish captured within a portion of the Blackfoot River Wildlife Management Area (BRWMA) located about 51 km above the reservoir. The adfluvial escapement estimates have been completed every year since 2001. The river density surveys are completed less frequently.

An electric fish migration barrier was installed in the Blackfoot River in 2003 to collect migrating adult YCT. The barrier includes a trap box designed using Smith Root Inc. specification. The barrier components include four flush mounted electrodes embedded in Insulcrete, four BP-POW pulsators, and a computer control and monitoring system. The computer system can be operated remotely, records electrode outputs, and has an alarm system that triggers during power outages. Detailed descriptions of these components and their function can be obtained at www.smith-root.com.

The electric barrier was not operated during the 2017 migration season. Normally we operate the trap from 1 May until the migration run has ended, which generally occurs around the first week of June. However, in 2017 river discharge was too high to operate the trap effectively.

In 1994, the Idaho Department of Fish and Game (IDFG), with assistance from the Conservation Fund, purchased a 700 ha ranch and began managing the property as the BRWMA. The BRWMA straddles the upper Blackfoot River, with an upper boundary at the confluence of Lanes, Diamond, and Spring creeks and a lower boundary at the head of a canyon commonly known as the upper narrows. Approximately 9 km of river meander through the property along with 1.6 km of Angus Creek, which is an historical YCT spawning and rearing stream. Since purchasing the BRWMA, IDFG has completed periodic population estimates to monitor native YCT abundance.

We estimated YCT abundance within 5.2 km of the BRWMA reach of the Blackfoot River in 2017. The estimate was completed using mark-recapture methods. Fish were sampled with drift boat-mounted electrofishing gear employing standard pulsed DC waveforms. All YCT captured were injected (marked) with a 23 mm PIT tag (oregonrfid.com), measured for total length (mm) and weighed to the nearest gram and released. Fish were marked on 21 - 22 June and recaptured on 24 - 25 June. Data were analyzed using Fish Analysis + software package (Montana Fish Wildlife and Parks 2004).

RESULTS AND DISCUSSION

In 2017, the migration trap was not operated due to high water during the run. Mean May discharge was 25 m^3/s. Similarly, the mean June discharge of 12 m^3/s was also considerably higher than what is normally encountered. When river discharge reaches about 21 m^3/s, two issues arise. First, the water level in the trap box becomes too high to effectively crowd and extract fish. Secondly, the river begins to enter the floodplain which provides numerous avenues for fish to circumvent our trapping facilities. We anticipate being able to resume trapping activities in 2018. See Table 5 for historical adult YCT passage data.

A total of 355 YCT were sampled on the BRWMA during the mark and recapture electrofishing surveys (Table 6). The number of YCT captured in 2017 was lower than in 2016 (496). We estimate there were about 1,200 YCT / km at the time the surveys were completed. However, due to the low number of recaptures encountered during the survey (n = 3), caution should be used when drawing conclusions about this population estimate. We think American White Pelican *Pelecanus erythrorhynchos* predation on BRWMA YCT and high water encountered during the surveys were contributing factors to the low numbers of YCT encountered in 2017 (Table 6; Teuscher et. al 2015).

In past surveys of the BRWMA reach, juveniles (< 300 mm) dominated catch. Thurow (1981) reported that about 80% of the fish caught during population surveys were less than 300 mm total length. Results from 2014, 2015, 2016, and 2017 surveys show similar ratios of juvenile cohorts (Figure 6).

BONNEVILLE CUTTHROAT TROUT MONITORING PROGRAM

INTRODUCTION AND METHODS

Bonneville Cutthroat Trout *Oncorhynchus clarkii utah* (BCT) are one of three native Cutthroat Trout sub-species in Idaho. The distribution of BCT is limited to the Bear River drainage in southeastern Idaho. In the early 1980s, distribution and abundance data for BCT were deficient. To better understand BCT population trends and the potential influence of natural and anthropogenic processes, a long-term monitoring program was initiated for three tributary streams of the Thomas Fork Bear River (Preuss, Giraffe, and Dry Creeks). These streams were to be sampled every other year. In 2006, as part of the BCT Management Plan (Teuscher and Capurso 2007), additional streams were added to the BCT monitoring program to implement a broader representation of BCT population trends from across their historical range in Idaho. These additional monitoring streams included Eightmile, Bailey, Georgetown, Beaver, Whiskey, Montpelier, Maple, Cottonwood, Snow slide, First, Second, and Third creeks, and the Cub River. In 2010, we determined that the monitoring program would be better represented by dropping some sites and streams initiated in 2006, while adding other streams throughout the four BCT management units in the Bear River drainage (Figure 7). Currently, the monitoring program consists of three streams and eight sites in the Pegram Management Unit (PMU), six streams and 14 sites in the Nounan Management Unit (NMU), four streams and nine sites in the Thatcher Management Unit (TMU), four streams and eight sites in the Riverdale Management Unit (RMU), and three streams and six sites in the Malad Management Unit (MMU; Table 7). We sample half of these streams annually. In addition, the monitoring program includes two segments of the main-stem Bear River in each of the management units. Main-stem Bear River segments in each management unit are sampled every four years.

There are a number of variables that may influence BCT population trends which include annual precipitation, water temperature, irrigation, grazing, etc. (Teuscher and Capurso 2007). Given the sensitive status of BCT and recent petitions to list them under the Endangered Species Act, it is important to identify and correlate variation in BCT densities that appear to be associated with these and other potential variables. Therefore in 2011, we collected a suite of habitat variables to begin monitoring potential changes in habitat and stream channel condition. The descriptions of these habitat variables and collection methods are listed in Table 8. Once sufficient data have been collected, habitat data will be correlated to variation in BCT abundance.

To calculate mean BCT densities, we sampled at least two sites on each stream using multiple pass removal techniques with backpack electrofishing equipment. At each site, a segment of stream (approximately 100 m) was sampled, which included block nets at the downstream and upstream boundaries. The area (m^2) sampled was calculated using length (m) and average width (m). We calculated a population estimate using Microfish 3.0 software (Microfish Software, Durham, NC, USA). Bonneville Cutthroat Trout percent composition was calculated by dividing the number of BCT by the total number of all salmonids sampled. Mean densities and percent composition for an entire stream was calculated by averaging the mean values from each site within a stream. Relative Weights (W_r) were calculated for individual fish using the standard weight equation developed for Cutthroat Trout (Kruse and Hubert 1997). Mean W_r for each stream was calculated by averaging individual relative weights.

RESULTS AND DISCUSSION

In 2017, 10 streams were sampled which included seven sites within the TMU, eight sites in the RMU and five sites in the MMU (Figure 7). We did not sample any sites on Trout Creek because water levels were too high. Overall, mean BCT density was 10.3 BCT/100 m^2 (± 3.3 S.E; range 0.34 – 36.9). The highest BCT density was observed in Third Creek (36.9 BCT/100 m^2) and the lowest was in Whiskey Creek (0.3 BCT/100 m^2). The percent composition of BCT in relationship to other salmonids sampled varied between streams. The percent composition of BCT was lowest in Whiskey Creek (42%) and the highest was observed in Third, Stockton, Hoopes, First, and Second Creeks, and the Logan River at 100% (Table 9). Bonneville Cutthroat Trout densities for all the years that these streams have been sampled are illustrated in Figure 8 and Table 9.

In the TMU, BCT densities have shown a slight increase in 2017 when compared to 2015 sampling efforts in all streams except for Whiskey Creek (Figure 8). In 2011, IDFG began stocking BCT into numerous streams in the TMU including Whiskey Creek. The percent composition of BCT in Whiskey Creek has continued to increase since then, but in 2017 there was a decrease (Table 9). In the future, we expect to see an increase in BCT densities in Whiskey Creek. In 2015, there was a spawning channel created on the Whiskey Creek Ranch property to increase the amount of available spawning habitat. We were not able to sample any of the sites on Trout Creek due to high water throughout the summer. In the RMU, BCT densities increased in 2017 when compared to 2015 except for Beaver Creek (Figure 9). In fact, BCT densities were among the highest recorded in all streams that had increased densities. In the MMU, BCT density estimates were the highest recorded for Third Creek (Figure 10). The 2017 BCT density estimates were a substantial increase from our estimates in 2015. This was the first year that we sampled and calculated BCT densities in First and Second Creek.

SNAKE RIVER CREEL

INTRODUCTION AND METHODS

The Snake River below American Falls Dam is the most popular tailwater fishery in Southeast Idaho. Annual angling effort ranges from 30,000 to 60,000 angler hours per year (Brimmer et al. 2011). An abundance of Rainbow Trout *Oncorhynchus mykiss* (RBT), Yellowstone Cutthroat *Oncorhynchus clarkii bouvieri*, and Brown Trout *Salmo trutta* longer than 400 mm are the main attraction. However, in the last two decades, introductions of hatchery-reared White Sturgeon *Acipenser transmontanus* and Smallmouth Bass *Micropterus dolomieu* have increased the diversity and popularity of the fishery (Brimmer et al. 2011).

Previous studies evaluating the relationship between American Falls Reservoir management and the tailwater fishery verified that the majority of trout below the dam were hatchery-produced RBT stocked in the reservoir several months to several years prior (Brimmer et al. 2011; Smith 1991; Heimer and Howser 1990; Heimer 1984; Casey 1967). These trout experience excellent growth both in the reservoir before they are entrained below the dam (Brimmer et al. 2011), as well as while living in the tailwater below. Heimer and Howser (1990) estimated survival of trout entrained through the dam to be about 65%.

Prior to 2011, the Snake River from Eagle Rock upstream to American Falls Dam was closed to angling from 1 November through the Friday before Memorial Day. In 2009, anglers proposed a regulation change that would open the fishery to catch-and-release angling during the winter months. In January of 2011, the proposed rule change was adopted.

The main objective of this project was to determine if the winter catch-and-release season has negatively affected catch rates and/or the size structure of trout caught in the Snake River below American Falls Dam (AFD). A second objective was to analyze the effects of stocking sterile (triploid) versus viable (diploid) trout on opening day catch rates and size structure of the Snake River trout population below AFD.

Creel surveys were conducted during the Memorial Day harvest season opener from 1997-2017. The majority of surveys were access point creel surveys conducted at Three Layer Park boat ramp below AFD. Anglers were interviewed upon completion of their trip. We recorded total lengths (mm) and weights (g) of harvested fish. In addition, several roving creel surveys were completed at Three Layer Park and Pipeline, the majority of anglers interviewed using this method had not completed their trip. We grouped the creel data in the following ways: 1997 – 2011 (pre-regulation change) and 2012 – 2017 (post-regulation change). We grouped the data in this manner because the first full winter catch and release season did not occur until 2011-12.

Creel data from 1997 through 2017 were used to generate length frequency histograms, calculate harvest and catch rates, and to calculate Relative Weight (W_r), and Quality Stock Density (QSD) indices. We calculated QSD to determine if switching from stocking diploid to triploid trout has increased the size structure of trout in the fishery below AFD. Trout harvested before 2006 were treated as diploid, and trout harvested since 2006 were treated as triploid. Quality Stock Density was calculated by dividing the number of tout harvested ≥ 600 mm by the number of RBT ≥ 500 mm, then multiplied by 100 (Schrader and Fredericks 2006).

RESULTS AND DISCUSSION

Since the regulation change in 2011, there has been no significant change in mean catch rate (t = 1.65, df = 256, P = 0.58). However, the mean length of trout in the harvest has increased from 438 mm (1997-2011) to 479 mm (2012-2017; t = 1.28, df = 808, P = 0.000) and the harvest rate of trout ≥ 508 mm increased from 0.04 trout per hour to 0.10 trout per hour (t = -2.198, df = 6, P = 0.07; Table 10). However, despite the increases described in the metrics above, angler participation on opening day of the harvest season has declined since the establishment of the winter catch-and release season. From 1997-2011, mean angler participation on opening day was significantly higher (221) than from 2012 – 2017 (84; t = 1.75, df = 15, P = 0.000; Table 11). We do not know why this change has occurred, but it may be tied to angler perception. We think some anglers perceive that the quality of the fishery has been diminished due the addition of the winter catch-and-release season and therefore, do not participate. In summary, these results show that the adoption of the rule change in 2011 has not reduced angler success or diminished the size structure of the trout population during the harvest season but has resulted in reduced angler participation on opening day of the harvest season (Figure 11; Table 11).

We think the increase in trout size and other metrics described above, is likely due to the introduction of triploid trout in 2004. The analysis of length frequency distributions showed the mode shifted from 430 mm for diploid trout to 480 mm for triploid trout (Figure 12). The triploid group of trout also showed a higher frequency of fish ≥ 600 mm than what we found in the diploid group. Quality Stock Density increased from 1% for the diploid group of trout to 14% for the triploid group. The increase in size of trout harvested by anglers coupled with the relative increase in QSD suggests that triploid trout have out-performed diploid trout in the Snake River fishery (Table 12). Several studies have shown direct linkages between entrainment of RBT through AFD and the relative success of the RBT fishery in the Snake River below the dam (see Introduction). However, to date, no studies have been completed that explore the relationship between AFD pool elevation and the possible impacts to the fishery below the dam. We recommend that openeing day creel data continue to be collected so that in the future these relationships can be explored further and better understood.

In summary, catch rates and size structure of trout harvested from the Snake River below AFD have not been negatively impacted by the addition of the winter catch-and-release season. Trout size structure in the fishery has increased over the last decade. This increase has likely been the result of switching from stocking Hayspur diploid RBT to Troutlodge triploid RBT. The increase in size of trout in the fishery is likely due to longer lived triploid RBT. These results are similar to observations made in Treasureton Reservoir (Brimmer et al. 2018; Dillon et al. 2000).

MANAGEMENT RECOMMENDATIONS

1. Continue evaluation of Yellowstone Cutthroat Trout life history metrics of the Blackfoot River population.
2. Continue estimating impacts of pelican predation on Yellowstone Cutthroat Trout on the Blackfoot River.
3. Continue Bonneville Cutthroat Trout monitoring.

Table 5. Yellowstone Cutthroat Trout escapement estimates for the Blackfoot River 2001-2017. No escapement estimates are available for 2011 or 2017 due to extremely high river discharge during the migration season which resulted in poor tapping efficiency.

Year	Weir Type	YCT Count	Mean Length(mm)	% Bird Scars	Mean May River Discharge (cfs)	Adult Pelican Count
2001	Floating	4,747	486	N/A	74	N/A
2002	Floating	902	494	0	132	1,352
2003	Electric	427	495	N/A	151	1,674
2004	Electric	125	478	70	127	1,748
2005	Electric	16	N/A	6	388	2,800
2006	Electric	19	N/A	38	453	2,548
2007	Electric	98	445	15	115	3,416
2008	Electric	548	485	10	409	2,390
2009	Electric	865	484	14	568	3,174
2010	Electric	938	468	12	248	1,734
2011	Electric	N/A	N/A	N/A	936	724
2012	Electric	530	483	37	200	3,034
2013	Electric	1,843	486	34	176	1,996
2014	Electric	807	487	24	302	2,096
2015	Electric	190	496	7	278	1,466
2016	Electric	204	496	10	316	974
2017	Electric	N/A	N/A	N/A	870	1,232

Table 6. Yellowstone Cutthroat Trout (YCT) population and density estimates collected from the Blackfoot River Wildlife Management Area of the Blackfoot River, Idaho.

Year	Fish Marked	Fish Captured	Fish Recaptured	% Recaptured	Pop. Estimate	Pop. Estimate SD	Density YCT / km
2005	266	202	20	7.5	3,664	569.1	421
2006	339	450	57	16.8	3,534	352.3	406
2008	223	186	28	12.6	2,504	336.5	288
2009	279	319	44	15.8	2,567	286.5	494
2010	317	272	11	3.5	12,944	4,131.2	2,489
2011	318	147	16	5.0	3,222	411.3	620
2012	137	99	12	12.1	1,672	421.7	322
2013	65	N/A	N/A	N/A	N/A	N/A	N/A
2014[a]	137	130	12	9.2	2,147	417.9	413
2015	149	119	14	11.8	3,659	593.9	704
2016	210	309	23	7.4	2,717	386.3	522
2017	191	167	3	1.8	7,343	1,530.2	1,412
Mean[b]	229	218	25	11	2,854	419.5	466

[a] Excludes adfluvial fish > 400mm
[b] Excludes 2010, 2013, and 2017

Table 7. Monitoring streams and sites within the 5 BCT management units, including length (km) of stream sampled, total stream length (km), and the percent of stream sampled.

Management Unit	Stream	Sites	Stream Sampled (km)	Stream Length (km)	Percent Sampled
Pegram	Dry Ck.	2	0.2	13.4	1.5
	Giraffe Ck.	2	0.2	5.7	3.5
	Preuss Ck.	4	0.4	22.0	1.8
	Bear River	2	17.2	61.2	28.1
Nounan	Bailey Ck.	2	0.2	9.9	2.0
	Eightmile Ck.	3	0.3	23.6	1.3
	Georgetown Ck.	3	0.3	21.8	1.4
	Montpelier Ck.	2	0.2	36.0	0.6
	Pearl Ck.	2	0.2	5.3	3.8
	Stauffer Ck.	2	0.2	14.5	1.4
	Bear River	2	18.8	94.5	19.9
Thatcher	Cottonwood Ck.	3	0.3	37.4	0.8
	Hoopes Ck.	2	0.2	13.5	1.5
	Trout Ck.	2	0.2	18.3	1.1
	Whiskey Ck.	2	0.2	5.1	3.9
	Bear River	2	18.0	37.8	47.6
Riverdale	Beaver Ck.	2	0.2	13.7	1.5
	Logan R.	2	0.2	4.7	4.3
	Maple Ck.	3	0.3	16.1	1.9
	Stockton Ck.	2	0.2	9.8	2.0
	Bear River	2	13.6	50.2	27.1
Malad	First Ck.	2	0.2	9.0	2.2
	Second Ck.	2	0.2	8.4	2.4
	Third Ck.	2	0.2	11.2	1.8

Table 8. List of habitat variables, units of measurement and collection methods for habitat characteristics used to explain variation in BCT abundance estimates.

Habitat Variable	Unit of Measurement	Collection Methods
Water Temperature	Celsius	Measured at beginning of survey with handheld thermometer to the nearest ± 0.5 (°C).
Conductivity	µs/cm	Measured at beginning of survey with conductivity meter to the nearest ± 0.1 (µs/cm).
Discharge	ft^3/sec	Measured stream discharge with Rickly discharge meter in a uniform stream segment, using methods proposed by Harrelson et al. (1994)
Gradient	Percent	Gradient was calculated using aerial imagery by calculating the difference in water elevation from an upstream location to a downstream location that was greater than 50 meters apart.
Stream Width	Meters	Measure the wetted width (± 0.1 m) of the stream at ten (10) equally spaced transects within the survey reach and then calculate the mean reach width.
Stream Depth	Centimeters	At ten (10) equally spaced transects, measure and sum the depth (± 1 cm) of the stream at ¼, ½, and ¾ distance across the channel and divide by four. Use these values to calculate the mean reach depth.
Width/Depth Ratio	Meters	Convert the mean reach depth into meters. Divide the mean reach width by the mean reach depth.
Percent Stable Banks	Percent	At the ten (10) equally spaced transects, determine and circle if the bank on the left and right are stable using the following definition. Streambank is stable if they DO NOT show indications of alteration such as breakdown, erosion, tension cracking, shearing, or slumping.
Total Cover	Percent	Followed instructions from the streambank cover form in Bain and Stevenson (1999).
Canopy	Percent	Used a spherical densiometer and followed the methods of Platts et al. (1987).

Table 9. Descriptive values of Bonneville Cutthroat Trout population trends for the Riverdale, Thatcher and Malad Geographic Management Units (GMU).

GMU	Stream	Year	Sites	BCT/100m² Mean	BCT/100m² SE	% Comp	Mean Rel. Wt. (W_r)
Riverdale	Beaver Ck.	2006	3	6.0	2.6	45	88
		2009	3	1.3	0.5	26	89
		2011	2	0.6	0.3	19	102
		2013	2	0.8	0.5	89	89
		2015	2	5.7	0.1	77	100
		2017	2	3.2	1.0	62	84
	Logan R.	2001	1	16.4	N/A	100	
		2009	1	13.9	N/A	92	95
		2011	2	14.2	2.8	99	103
		2013	1	4.8	N/A	93	105
		2015	1	5.2	N/A	90	
		2017	2	14.9	5.1	100	99
	Maple Ck.	2001	2	3.3	1.2	100	
		2006	2	9.0	3.0	100	83
		2009	3	10.9	2.8	98	88
		2011	2	11.0	1.3	100	93
		2013	2	8.2	1.2	99	95
		2015	2	3.9	1.5	85	102
		2017	2	10.5	2.5	90	88
	Stockton Ck.	2010	2	8.0	5.0	97	90
		2011	2	5.4	2.6	100	97
		2013	2	4.0	2.7	100	108
		2015	2	4.0	2.7	100	82
		2017	2	9.8	2.7	100	89
Thatcher	Cottonwood Ck.	2006	3	3.5	2.1	100	90
		2007	2	19.0	9.0	100	97
		2008	2	12.8	10.3	92	92
		2011	3	11.4	4.6	97	86
		2013	2	8.3	0.1	85	89
		2015	3	3.4	1.7	99	86
		2017	3	9.6	4.1	96	84
	Hoopes Ck.	2011	2	0.9	0.2	100	93
		2015	1	4.4	N/A	100	112
		2017	2	5.1	1.5	100	87
	Trout Ck.	2007	1	0.0	N/A	0	
		2011	2	2.0	2.0	42	91
		2013	1	9.7	N/A	91	86
		2015	2	2.4	2.4	64	82
	Whiskey Ck.	2006	1	0.0	N/A	0	
		2011	2	0.1	0.1	4	
		2013	2	1.5	1.0	43	75
		2015	2	0.7	0.4	54	85
		2017	2	0.3	0.3	42	83

Table 9 (continued)

GMU	Stream	Year	Sites	BCT/100m^2 Mean	SE	% Comp	Mean Rel. Wt. (W_r)
Malad	Third Ck.	2000	2	3.2	1.0	100	
		2006	2	1.0	1.0	100	
		2010	3	1.7	0.9	100	81
		2011	2	23.0	1.3	97	88
		2013	2	27.2	23.2	100	82
		2015	2	3.8	3.8	100	80
		2017	2	36.9	21.9	100	87
	Second Ck.	2017	1	11.6	N/A	100	90
	First Ck.	2017	2	1.4	1.4	100	90

Table 10. Catch rates, size and Relative Weight (W_r) of Rainbow Trout (RBT) harvested during opening day of the harvest season on the Snake River from Eagle Rock upstream to American Falls Dam. Pre-regulation change data was collected from 1997-2011 and post regulation change data was collected from 2012 – 2017.

Years	Mean Catch Rate (RBT/h)	W_r	Mean Total Length (mm)	Percent RBT Harvested ≥ 508 mm	Harvest Rate of RBT ≥ 508 mm (fish/h)
1997-2011	0.86	102	438	13	0.04
2012-2017	0.96	101	479	30	0.10

Table 11. Summary of Snake River creel data from below American Falls Dam from 1997-2017. The catch and release winter angling season was adopted in January of 2011.The first full catch and release season occurred in 2011-2012.

Year	Snake River Discharge (cfs)	Number Anglers	Mean Harvest Rate (f/h)	Trout Harvested	Mean Relative Weight (W_r)	Mean Length (mm)	Percent Trout ≥ 508 mm	Harvest Rate of Trout ≥ 508 mm (f/h)
1997	19,900	162	1.17	378	N/A	429	12	0.09
1998	21,500	488	1.26	945	N/A	412	9	0.05
1999	18,700	366	0.91	661	113	419	9	0.04
2000	10,600	576	0.53	400	111	445	13	0.02
2001	10,800	257	1.02	459	98	430	16	0.06
2002	7,750	344	0.68	491	96	430	7	0.02
2003	9,870	187	0.77	264	75	409	3	0.01
2004	7,260	165	1.06	274	81	440	3	0.01
2005	6,690	159	0.79	226	120	420	3	0.01
2006	9,370	105	1.23	105	107	441	13	0.04
2007	9,000	168	1.08	329	116	439	15	0.06
2008	8,140	130	1.05	202	90	471	30	0.10
2009	10,600	90	0.47	100	125	474	26	0.06
2010	9,370	89	0.39	153	110	437	12	0.05
2011	26,900	30	0.43	16	84	475	31	0.06
2012	9,680	73	1.16	114	100	454	19	0.09
2013	9,680	80	1.20	124	102	490	35	0.14
2014	10,500	112	0.58	80	N/A	486	46	0.06
2015	7,420	105	0.59	120	85	445	6	0.01
2016	9,150	77	1.27	133	109	476	30	0.13
2017	9,660	60	0.97	96	111	522	45	0.14

Table 12. Quality Stock Density (QSD) of Rainbow Trout (RBT) harvested from the Snake River below American Falls Dam, Idaho.

Stock (Years)	RBT ≥ 500 mm	RBT ≥ 600 mm	QSD %
Diploid (1997 - 2005)	522	15	3
Triploid (2006 - 2017)	472	66	14

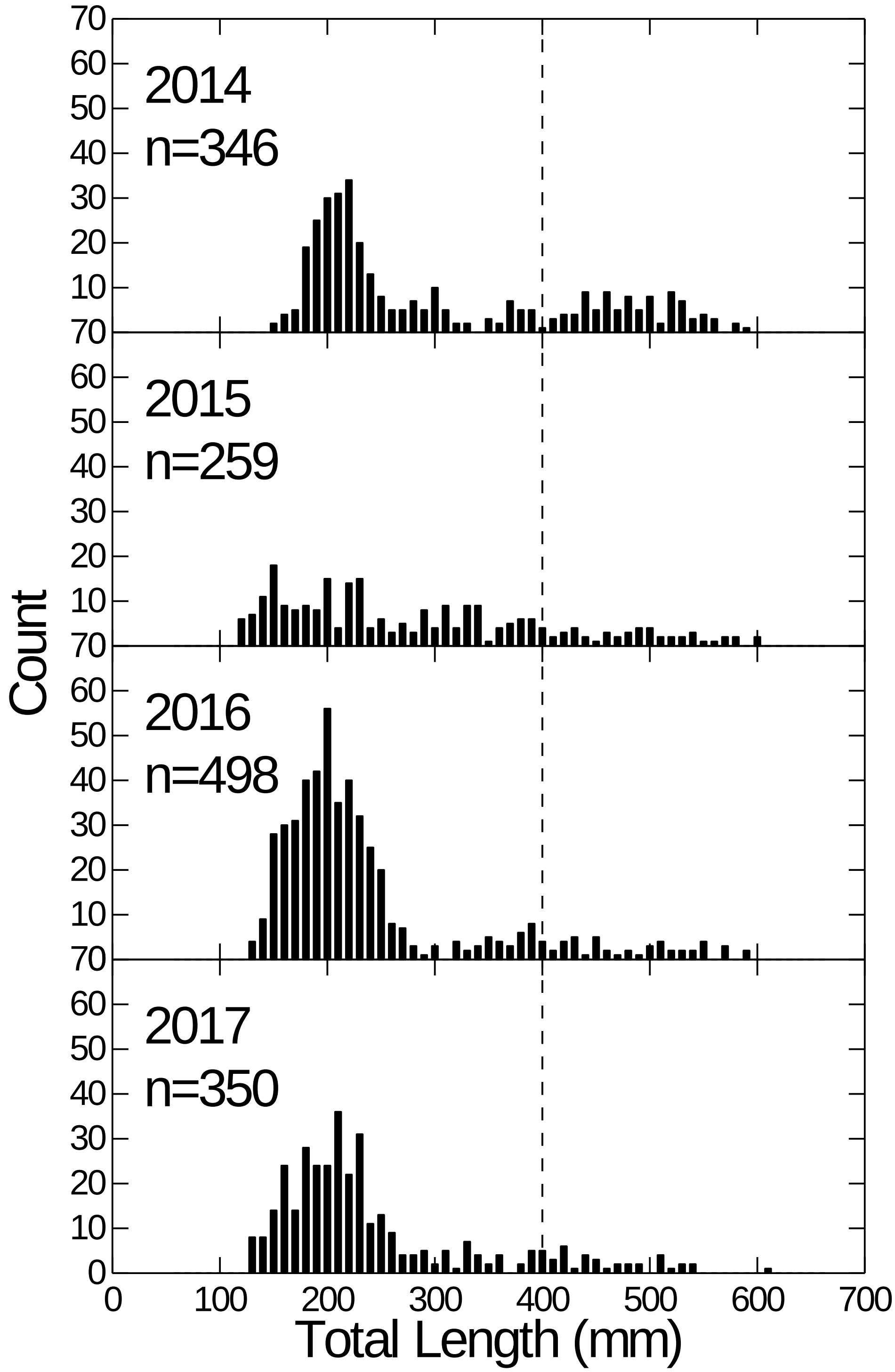

Figure 6. Length frequency distributions of Yellowstone Cutthroat Trout caught from the Blackfoot River Wildlife Management Area of the Blackfoot River, Idaho. The majority of fish located to the right of the vertical dashed lines are likely post spawn adfluvial fish that may return to Blackfoot Reservoir.

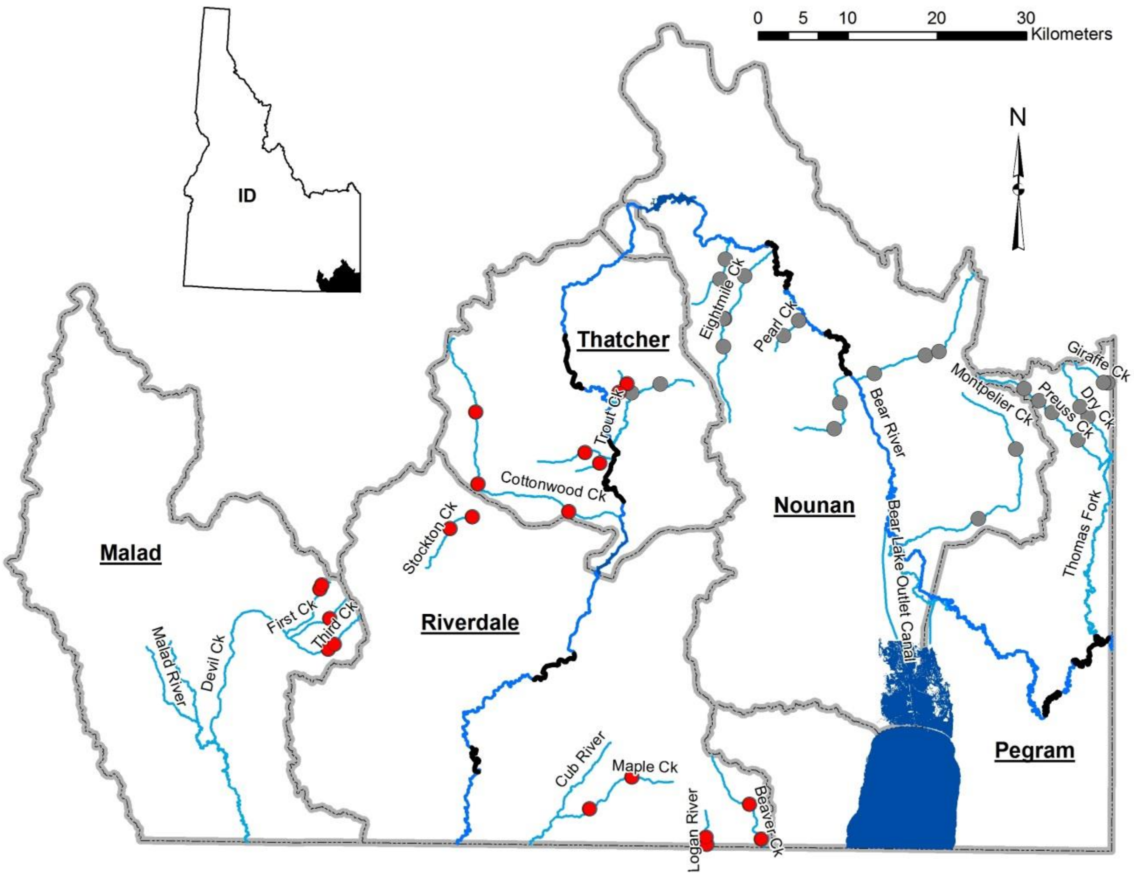

Figure 7. Map of the Bear River watershed in Idaho, including the five Bonneville Cutthroat Trout management units. The gray circles represent monitoring sites and red circles represent sites that were sampled in 2017. The black line segments on the main-stem Bear River represent monitoring reaches. There were no Bear River main-stem reaches monitored in 2017.

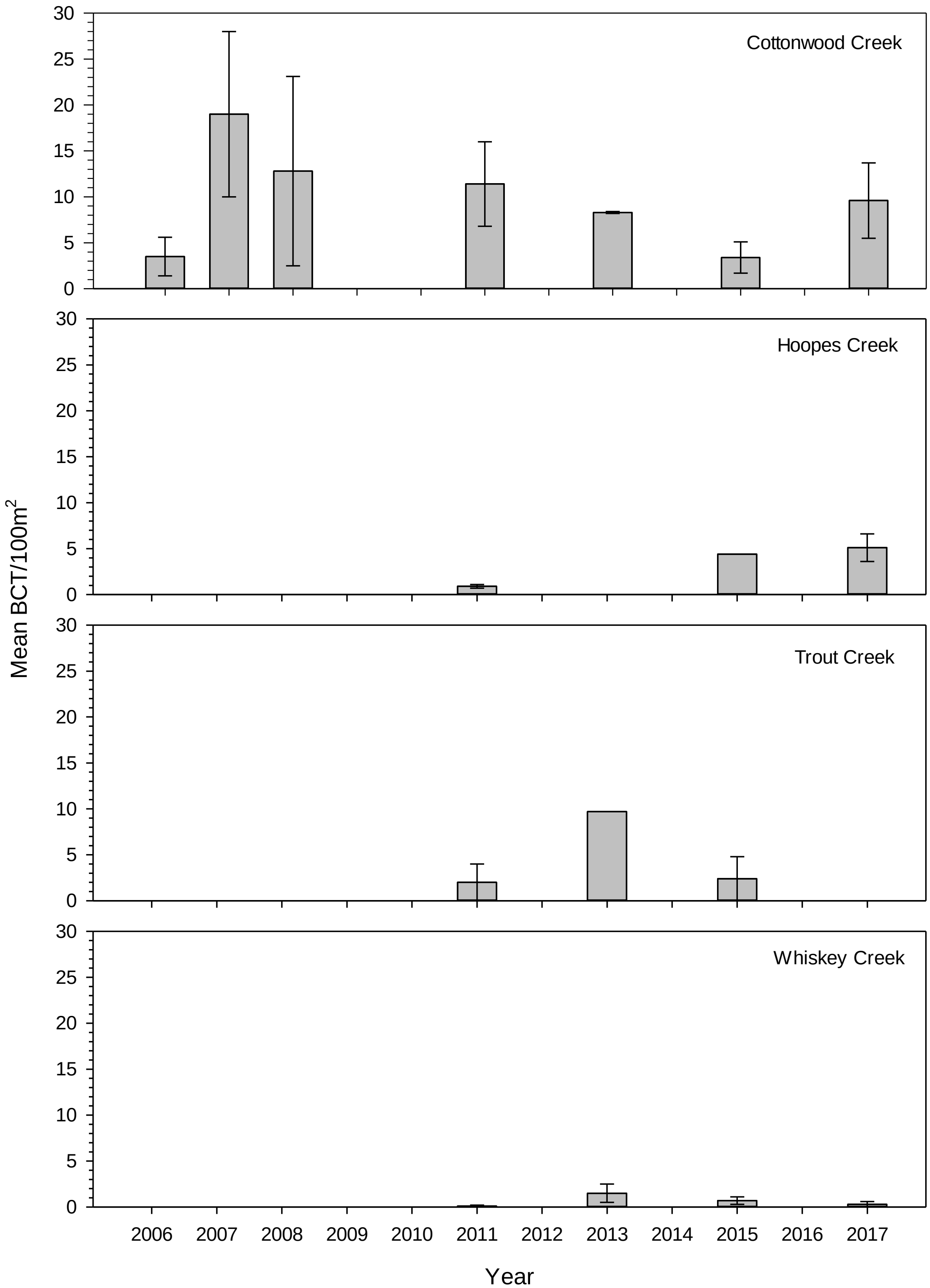

Figure 8. Mean BCT density (BCT/100m^2) trends in streams located in the Thatcher Management Unit.

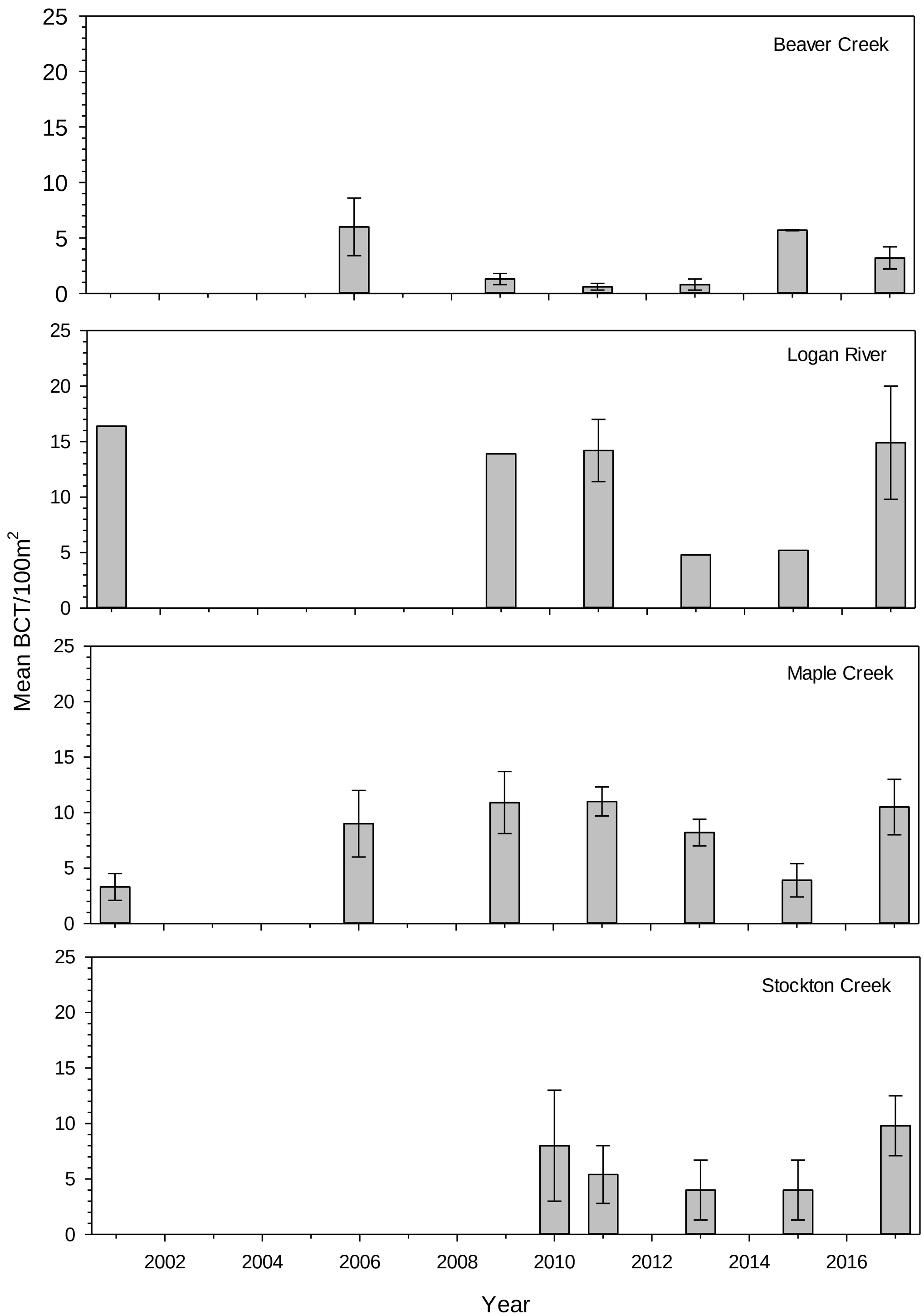

Figure 9. Mean BCT density (BCT/100m^2) trends in streams located in the Riverdale Management Unit.

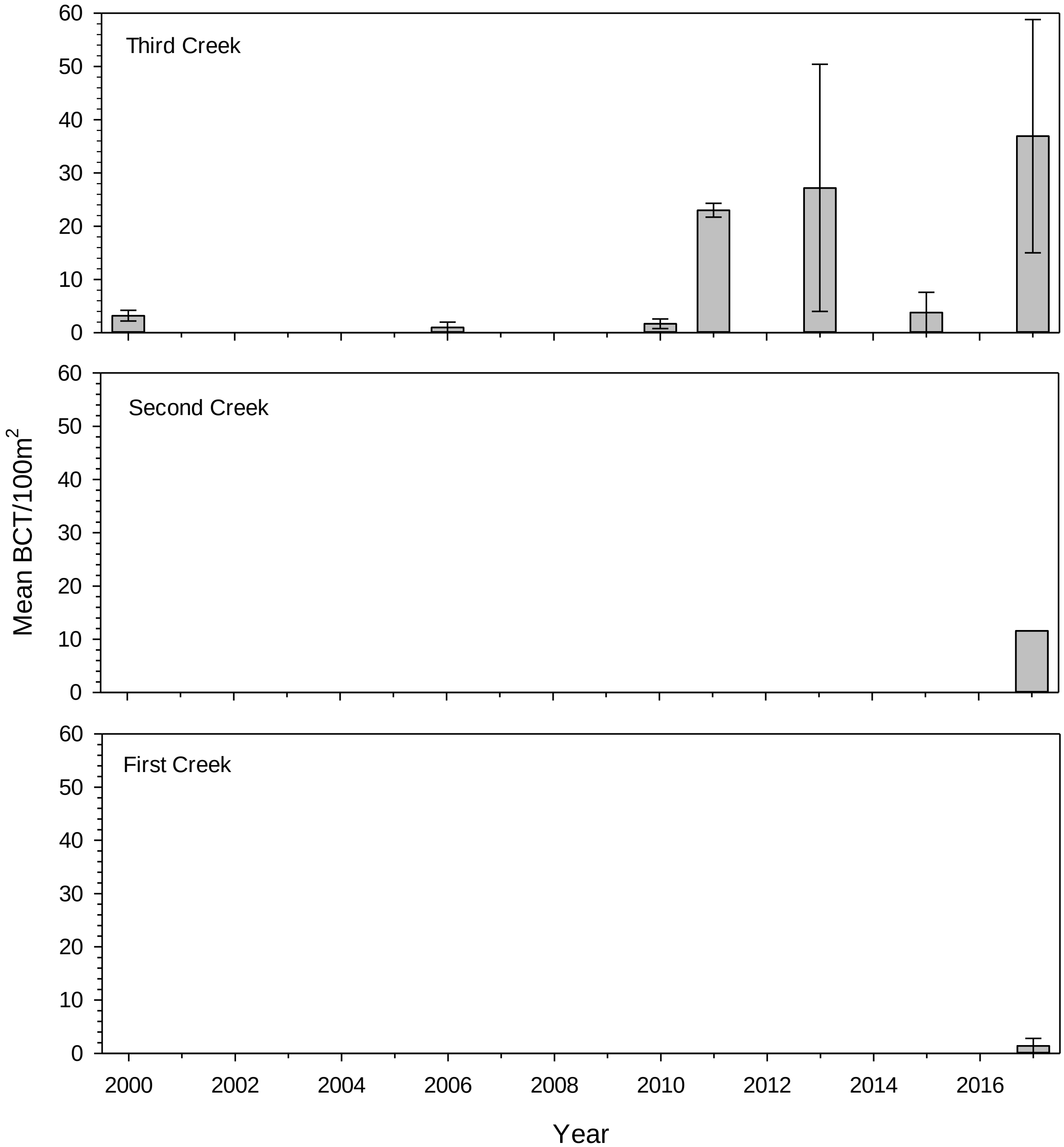

Figure 10. Mean BCT density (BCT/100m^2) trends in streams located in the Malad Management Unit within the Bear River drainage, Idaho.

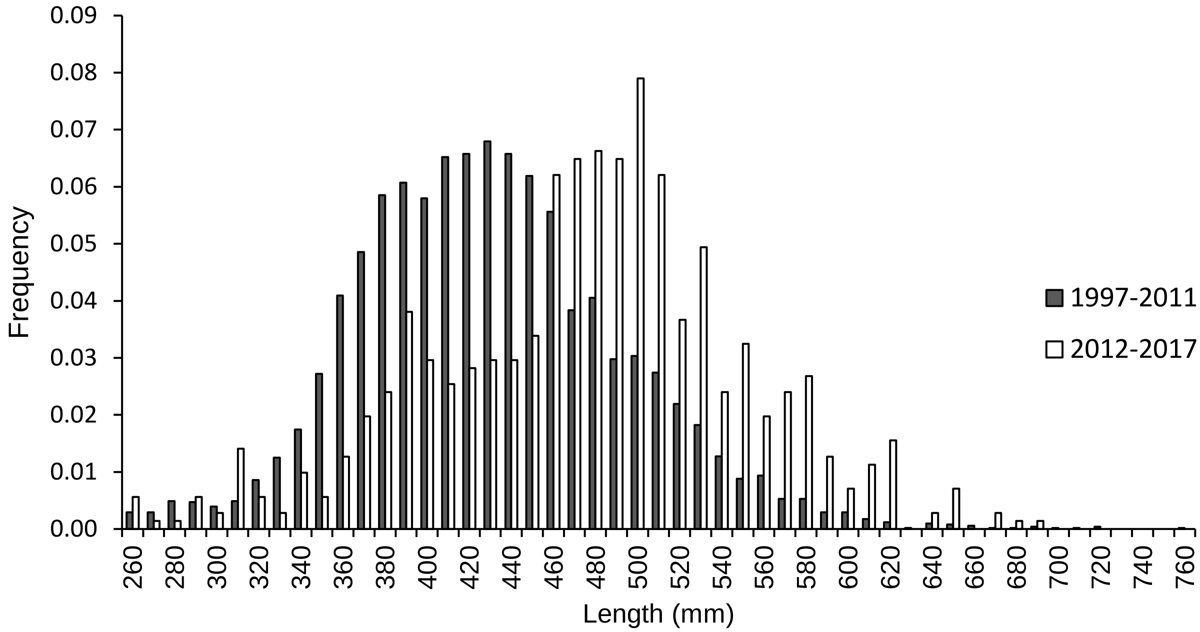

Figure 11. Length frequency of trout pre-regulation change (1997 - 2011; *n* = 5,108) and post regulation change (2012 – 2017; *n* = 709).

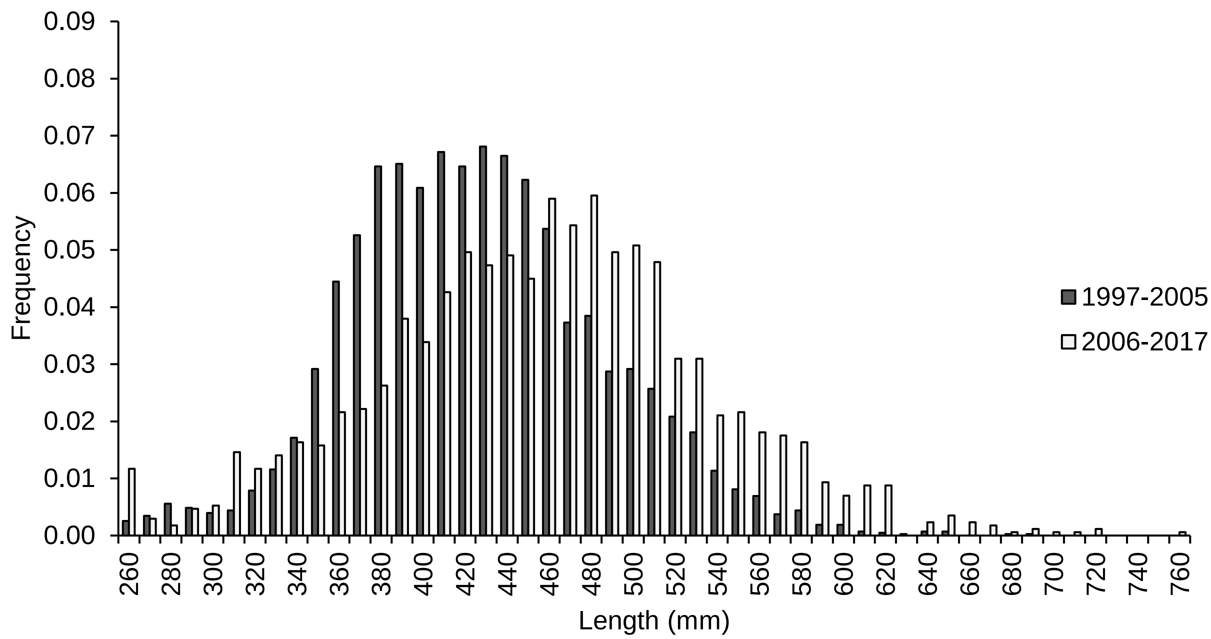

Figure 12. Length frequency distribution of diploid Rainbow Trout (RBT) and triploid RBT harvested from the Snake River below American Falls Dam. Diploid RBT data are reported for 1997 – 2005 (*n* = 4,319) and triploid RBT data are reported for 2006 – 2017 (*n* = 1,713).

LITERATURE CITED

Bain, M. B., and N. J. Stevenson, editors. 1999. Aquatic habitat assessment: common methods. American Fisheries Society, Bethesda, Maryland.

Beamesderfer, R. C. P. and J. A. North. 1995. Growth, natural mortality, and predicted response to fishing for Largemouth Bass and smallmouth bass populations in North America. North American Journal of Fisheries Management 15:688-704.

Birdsey, P. W. 1989. The limnology of Bear Lake, Utah-Idaho, 1912-1985: a literature review. Utah Division of Wildlife Resources, Federal Aid in Fish Restoration, Publication Number 89-05. Salt Lake City.

Brimmer, A., R.,Hillyard, and D. Teuscher. 2018. Regional Fishery Management Investigations. Idaho Department of Fish and Game, 2016 Fishery Management Annual Report South East Region 17-106, Boise.

Brimmer, A., R.,Hillyard, and D. Teuscher. 2011. Regional Fishery Management Investigations. Idaho Department of Fish and Game, 2010 Fishery Management Annual Report South East Region 11-116, Boise.

Casey, O.E., 1967. Test for increasing the returns of hatchery trout. Idaho Department of Fish and Game. Job Performance Report F 32-R-6, Boise.

Dillon, J.C, D.J. Schill, and D. M. Teuscher. 2000. Relative Return to Creel of Triploid and

Diploid Rainbow Trout Stocked in Eighteen Idaho Streams. North American Journal of Fisheries Management 20:1-9.

Dillon, J. C., and C.B. Alexander. 1995. Project 8. Put and Grow Hatchery Trout Evaluations. Idaho Department of Fish and Game. Job Performance Report. Project F-73-R-13, Boise.

Dillon, J. C. 1991. Lake and Reservoir Investigations. Largemouth Bass Forage Investigations. Idaho Department of Fish and Game, Job Performance Report, Project F-73-R-13, Boise.

Gablehouse, D. W., Jr. 1984. An Assessment of Largemouth Bass Slot Length Limits in Five Kansas Lakes. Kansas Fish and Game Commission, Comprehensive Planning Option, Federal Aid in Fish Restoration, Project FW-9-P-3, Pratt.

Harrelson, C. C., C. L. Rawlins, and J. P. Potyondy. 1994. Stream Channel reference sites: an illustrated guide to field techniques. U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-245, Fort Collins, Colorado.

Heimer, J.T., and S.T. Howser. 1990. Lake and Reservoir Investigations; American Falls Reservoir. Idaho Department of Fish and Game Job Performance Report, Project F-71-R-12, Boise.

Heimer,J.T. 1984. American Falls- Snake River Fisheries Investigations. Idaho Department of Fish and Game Final Report to Idaho Power Company, Boise.

Kruse, C. G. and W. A. Hubert. 1997. Proposed Standard Weight (W_s) Equations for Interior Cutthroat Trout. North American Journal of Fisheries Management 17:784-790.

McCauley, R. W. and D. M. Kilgour. 1990. Effect of air temperature on growth of Largemouth Bass in North America. Transactions of the American Fisheries Society 119:276-281.

Montana Fish, Wildlife and Parks. 2004. Fisheries Analysis +, Version 1.0.8. Bozeman, Montana.

Platts, W. S., C. Armour, G. D. Booth, M. Bryant, J. L. Bufford, P. Cuplin, S. Jensen, G. W. Lienkameemper, G. W. Minshall, S. B. Monsen, R. L. Nelson, L. R. Sedell, and J. S. Tuhy. 1987. Methods for evaluating riparian habitats with applications to management. U.S. Forest Service, General Technical Report INT-221, Ogden, Utah.

Schrader, W.C., and J. Fredericks. 2006. South Fork Snake River Investigations. Idaho Department of Fish and Game. 2003 Annual Job Performance Report 06-20. Project F-71-R-28, Boise.

Smith, R. 1991. Hatchery Trout Evaluations, American Falls Reservoir Fishery Evaluations. Study Completion Report, Idaho Department of Fish and Game Project F-71-R-13, Boise.

Teuscher, D. M., M. T. Green, D. J. Schill, A.F. Brimmer, and R.W. Hillyard. 2015. Predation by American White Pelicans on Yellowstone Cutthroat Trout in the Blackfoot River Drainage, Idaho. North American Journal of Fisheries Management 35:454-463.

Teuscher, D. and J. Capurso. 2007. Management plan for conservation of Bonneville Cutthroat Trout in Idaho. Idaho Department of Fish and Game, USDA Forest Service. IDFG 07-48.

Teuscher, D. M. and R. Scully. 2006. Regional Fishery Management Investigations. Idaho Department of Fish and Game, 2002 Fishery Management Annual Report South East Region, F-71-R-27, Boise.

Teuscher, D. M.,D.J. Schill, D.J. Megargle, and J. C. Dillon. 2003. Relative Survival and Growth of Triploid and Diploid Rainbow Trout in Two Idaho Reservoirs. North American Journal of Fisheries Management 23:983-988.

Teuscher, D. 1999. Idaho Department of Fish and Game, 1996 Job Performance Report, Subproject 2, Grant F-73-R-21, Boise.

Thurow, R. 1981. Blackfoot River and fisheries investigations. Idaho Department of Fish and Game, Job Completion Report, F-73-R-3, Boise.

Tolentino and Teuscher 2010. Bear Lake Fisheries Management Plan 2010. Utah Division of Wildlife Resources, Idaho Department of Fish and Game. IDFG Boise.

Prepared By:

Arnie Brimmer
Regional Fishery Biologist

Ryan Hillyard
Regional Fishery Biologist

Kaden Buer
Fisheries Technician

David Teuscher
Regional Fishery Manager

Approved By:
Idaho Department of Fish and Game

Joseph R. Kozfkay
State Fishery Manager

James P. Fredericks
Chief of Fisheries